

Claims:

1. 1. A translinear circuit implementing a piecewise-polynomial-continuous function containing a removable singularity in at least one segment thereof, comprising:
  - 3 a plurality of input transistors for receiving a respective plurality of input currents; and
  - 4 a circuit for providing a plurality of perturbation currents when said translinear circuit operates within said at least one segment containing a removable singularity;
  - 6 wherein said translinear circuit is configured to add said perturbation currents to those of said input currents received by said input transistors that are responsible for creating said removable singularity.
- 1 2. The circuit of claim 1 wherein said input currents are substantially proportional.
- 1 3. The circuit of claim 1 wherein said perturbation currents are substantially equal.
- 1 4. The circuit of claim 1 wherein said input transistors are bipolar transistors.
- 1 5. The circuit of claim 1 wherein said circuit for providing said perturbation currents comprises a Trafton-Hastings clamp transistor connected to provide a collector current that indicates when said input currents that are responsible for creating said removable singularity are substantially equal.
- 1 6. The circuit of claim 5 wherein said Trafton-Hastings clamp transistor is connected to produce a collector current that substantially differs from zero when said input currents that are responsible for creating said removable singularities are substantially equal.
- 1 7. The circuit of claim 6 wherein said perturbation currents are substantially proportional to said collector current of said Trafton-Hastings clamp transistor.
- 1 8. The circuit of claim 5 wherein said circuit for providing said perturbation currents further comprises a current mirror controlled by said Trafton-Hastings clamp transistor to supply said perturbation currents to said input transistors.
- 1 9. The circuit of claim 5 wherein said Trafton-Hastings clamp transistor is connected to produce a collector current that substantially equals zero when said input currents that are responsible for creating said removable singularities are substantially proportional.
- 1 10. The circuit of claim 5 further comprising a current source and a control transistor, connected in series, wherein a base of said Trafton-Hastings clamp transistor is connected to a node between said current source and said control transistor, and wherein said plurality of perturbation currents are substantially proportional

4 to a difference between a current delivered by the current source and a current consumed by said control  
5 transistor.

1 11. A method for operating a translinear circuit implementing a piecewise-polynomial-continuous function  
2 containing a removable singularity in at least one segment thereof, comprising:

3 applying a plurality of input currents to a respective plurality of input transistors;  
4 generating a plurality of perturbation currents when said translinear circuit operates within said at  
5 least one segment containing a removable singularity;

6 and allowing said translinear circuit to add said perturbation currents to those of said input  
7 currents received by said input transistors that are responsible for creating said removable singularities.

1 12. The method of claim 11 wherein said generating a plurality of perturbation currents comprises  
2 generating a plurality of substantially equal perturbation currents.

1 13. The method of claim 11 wherein said providing said perturbation currents comprises connecting a  
2 Trafton-Hastings clamp transistor to provide a collector current that indicates when said input currents that  
3 are responsible for creating said removable singularities are substantially proportional.

1 14. The method of claim 13 wherein said connecting a Trafton-Hastings clamp transistor comprises  
2 connecting a Trafton-Hastings clamp transistor to produce a collector current that substantially differs from  
3 zero when said input currents that are responsible for creating said removable singularities are substantially  
4 proportional.

1 15. The method of claim 14 wherein said providing said perturbation currents comprises providing  
2 perturbation currents that are substantially proportional to said collector current of said Trafton-Hastings  
3 clamp transistor.

1 16. The method of claim 13 wherein said providing said perturbation currents further comprises providing a  
2 current mirror controlled by said Trafton-Hastings clamp transistor to supply said perturbation currents to  
3 said input transistors.

1 17. The method of claim 13 wherein said connecting a Trafton-Hastings clamp transistor comprises  
2 connecting a Trafton-Hastings clamp transistor to produce a collector current that substantially equals zero  
3 when said input currents that are responsible for creating said removable singularities are substantially  
4 proportional.

1       18. The method of claim 13 further comprising providing a current source in series with a control transistor,  
2       connecting a base of said Trafton-Hastings clamp transistor to a node between said current source and said  
3       control transistor, wherein said plurality of perturbation currents are substantially proportional to a  
4       difference between a current delivered by the current source and a current consumed by said control  
5       transistor.

1       19. A method for perturbing a removable singularity in a piecewise-polynomial-continuous transfer  
2       function of a translinear circuit incorporating a Trafton-Hastings clamp, comprising:

3           detecting a region of operation wherein a removable singularity exists within a transfer function of  
4       said translinear circuit;

5           determining a plurality of input currents to the translinear circuit whose magnitude substantially  
6       equals zero at the removable singularity;

7           defining a plurality of substantially equal perturbation currents;

8           and within the region of operation adding a respective one of said plurality of perturbation currents  
9       to each of said input currents.

1       20. The method of claim 19 wherein said detecting a region of operation comprises detecting when a  
2       collector current of said Trafton-Hastings clamp transistor substantially differs from zero.

1       21. The method of claim 20 wherein said defining a plurality of substantially equal perturbation currents  
2       comprises defining said perturbation currents to be substantially proportional to said collector current of  
3       said Trafton-Hastings clamp transistor.

1       22. The method of claim 19 wherein said detecting a region of operation comprises detecting when a  
2       collector current of said Trafton-Hastings clamp transistor substantially equals zero.

1       23. The method of claim 19 further comprising connecting a base of said Trafton-Hastings clamp transistor  
2       to a node between a current source and a control transistor, wherein the plurality of perturbation currents  
3       are substantially proportional to a difference between a current delivered by said current source and a  
4       current consumed by said control transistor.

1       24. A translinear circuit, comprising:

2           a pair of translinear loops, including a respective plurality of bipolar input transistors each  
3       receiving a respective input current;

4           a current mirror having a plurality of outputs each connecting to a respective one of said bipolar  
5       input transistors; and

6 a Trafton-Hastings clamp transistor having a collector current coupled to control said outputs of  
7 said current mirror, said Trafton-Hastings clamp transistor being coupled to said translinear loops and  
8 operating to produce said collector current when said input currents cause said translinear circuit to operate  
9 in a segment of a piecewise-polynomial- continuous characteristic function having a removable singularity;  
10 wherein said outputs from said current mirror add to said input currents in said bipolar input  
11 transistors.

1 25. A translinear circuit having two translinear loops, comprising:  
2 a plurality of bipolar input transistors;  
3 a current mirror having a plurality of output currents to add to currents in said bipolar  
4 input transistors;  
5 a current source;  
6 a control transistor;  
7 a Trafton-Hastings clamp transistor having a base coupled to said current source and to a  
8 collector of said control transistor, a difference between a current delivered by said current source and a  
9 current consumed by said control transistor being coupled to said current mirror to be mirrored to said  
10 output currents.

1 26. A circuit comprising:  
2 a reference limb, a control limb, and an output limb,  
3 said reference limb comprising:  
4 a first bipolar transistor having an emitter coupled to a voltage rail, and  
5 a second bipolar transistor having an emitter coupled to a base of said first bipolar  
6 transistor;  
7 said control limb comprising:  
8 a third bipolar transistor having an emitter coupled to a voltage rail, and  
9 a fourth bipolar transistor having an emitter coupled to a base of said third bipolar  
10 transistor;  
11 said output limb comprising:  
12 a fifth bipolar transistor having an emitter coupled to a voltage rail, and  
13 a sixth bipolar transistor having an emitter coupled to a base of said fifth bipolar  
14 transistor;  
15 said second, fourth, and sixth bipolar transistors having bases coupled to a collector of said first  
16 bipolar transistor;  
17 a first constant current source coupled to said collector of said first bipolar transistor;  
18 a second constant current source coupled to said emitter of said second bipolar transistor;  
19 a third constant current source coupled to a collector of said third bipolar transistor,

20           a first input coupled to said emitter of said fourth bipolar transistor;  
21           a second input coupled to said emitter of said sixth bipolar transistor;  
22           a current mirror having outputs coupled to said emitters of said fourth and sixth bipolar transistors;  
23           a Trafton-Hastings clamp bipolar transistor, having a base coupled to said collector of said third  
24           bipolar transistor, an emitter coupled to said collector of said first bipolar transistor, and a collector coupled  
25           to an input of said current mirror; and  
26           and a circuit output coupled to a collector of said fifth bipolar transistor.

1       27. The circuit of claim 26, wherein a first current is passed through said first input and a second current is  
2       passed through said second input, and wherein said first and second currents are substantially equal.